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Systematics, biology and distribution of *Microdontomerus iridis* (Picard, 1930), comb. n. (Hymenoptera, Torymidae, Toryminae, Microdontomerini), a parasitoid of Mantodea oothecae

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Abstract

Here, we report on a unique parasitoid wasp species of Toryminae reared from oothecae of praying mantids in the Mediterranean region. Based on the first available large specimen series, we transfer the species to *Microdontomerus iridis* **comb. n.** (from *Torymus*), describe the so far unknown male, designate a neotype, expand the known geographical distribution by adding new records from Greece, Spain and Turkey, and provide the first images of live specimens of the species as well as information on its larval biology. We also transfer *Microdontomerus carayoni* comb. n. from *Idiomacromerus*.

Keywords

Chalcidoidea, Mediterranean area, ectoparasitoid, *Iris oratoria*, larval biology

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Introduction

Torymus iridis (Picard, 1930) is an exceptional species in the species-rich and biologically diverse subfamily Toryminae, as it is one of very few species with a reliable host record of Mantodea oothecae outside the strictly Mantodea oothecae-associated Podagrionini.

However, data on this species are very scarce. The only two published records are the original description by Picard (1930) from oothecae of *Iris oratoria* (Linnaeus, 1758) and an additional record from the same host species by Bernard (1936). Both records were restricted to France. The male remained unknown.

We reared a non-podagrionine species from *I. oratoria* oothecae collected in France, Greece, Spain and Turkey, and tentatively identified it as *Torymus iridis*. The availability of this larger series, for the first time also including males, led us to revise the taxonomic status of this biologically exceptional species.

In this study, we transfer the species to the correct genus and tribe, provide a description of the male, designate a neotype due to all historic material including the type specimens apparently having been lost, update and expand the known geographical distribution, and provide the first photographs of live specimens of the species as well as additional biological data.

Material and methods

Oothecae of *Iris oratoria* were collected from several locations in France, Greece, Spain and Turkey. Oothecae were collected in open Mediterranean steppe habitats under stones (Greece, Spain, and Turkey), glued to the substrate or to the stones, or very near the coast on outer walls or stakes (France).

The oothecae were subsequently stored in boxes or Petri dishes at room temperature. Emerging specimens were card mounted or stored in 96% alcohol at –20 °C. In total, we reared 23 females and 7 males of the wasp species from six oothecae of *Iris oratoria*. Additional oothecae of *Iris oratoria* were collected in Spain, some of which showed emergence holes similar to those formed by emerging wasps reared in the lab. These were dissected to check for parasitoid remains.

Pictures of live and mounted specimens were taken with a Keyence VHX-500F digital microscope. Other mounted specimens, including the neotype, were photographed with a JVC KY-75U 3CCD digital camera attached to an EntoVision binocular microscope, and the serial images obtained combined with Cartograph 5.6.0 (Microvision, Evry, France) software which allows precise measurements. Additional specimens were photographed with a Leica DXM 1200 digital camera attached to a Leica MZ 16 APO microscope and processed using Auto-Montage (Syncroscopy) software. Photographs were digitally optimized (artefacts removal, background standardization) using Photoshop® V. All figure plates were built using CorelDRAW®.

Characters used for measurements of all specimens, their definition and abbreviation are listed in App. 1. They mostly follow Graham (1969), Gibson et al. (1997),

Graham and Gijswijt (1998), Krogmann and Vilhelmsen (2006) and Baur (2015) or are newly defined. Some additional abbreviations which are not mentioned in Appendix 1 are: F1–F6 = funicle segments 1–6; Gt_1–Gt_5 = gastral terga 1–5; MPS = multiporous plate sensilla; OI (ovipositor index) = ratio of ovipositor length to length of metatibia. Terms for surface sculpture follow Harris (1979).

The measurements (in μm) of characters of individuals of both sexes are compiled in Suppl. material 1. An overview of the basic descriptive statistics for each body measurement and their ratios are given in App. 2 and 3. All measurements were made with special reference to the correct orientation: eye length was measured in dorsal view, oral fossa breadth was measured in ventral view; all mesosomal and gastral tergites were measured in dorsal view along the median line except length of pronotum which was measured from lateral view; ovipositor length was measured as the part of the ovipositor sheaths that extends beyond the tip of the last gastral tergite.

SEM images of uncoated specimens were prepared at the Department of Palaeontology of the National Museum in Prague using a Hitachi S-3700N scanning electron microscope.

Collection acronyms used are CUPC = Charles University in Prague, Faculty of Science, Department of Zoology, Prague, Czech Republic; GDPC = Gérard Delvare personal collection, Montpellier, France; MNHN = Muséum National d'Histoire Naturelle, Paris, France; SMNS = State Museum of Natural History Stuttgart, Germany; ZMH = Zoological Museum Hamburg, Germany; ZFMK = Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

Results

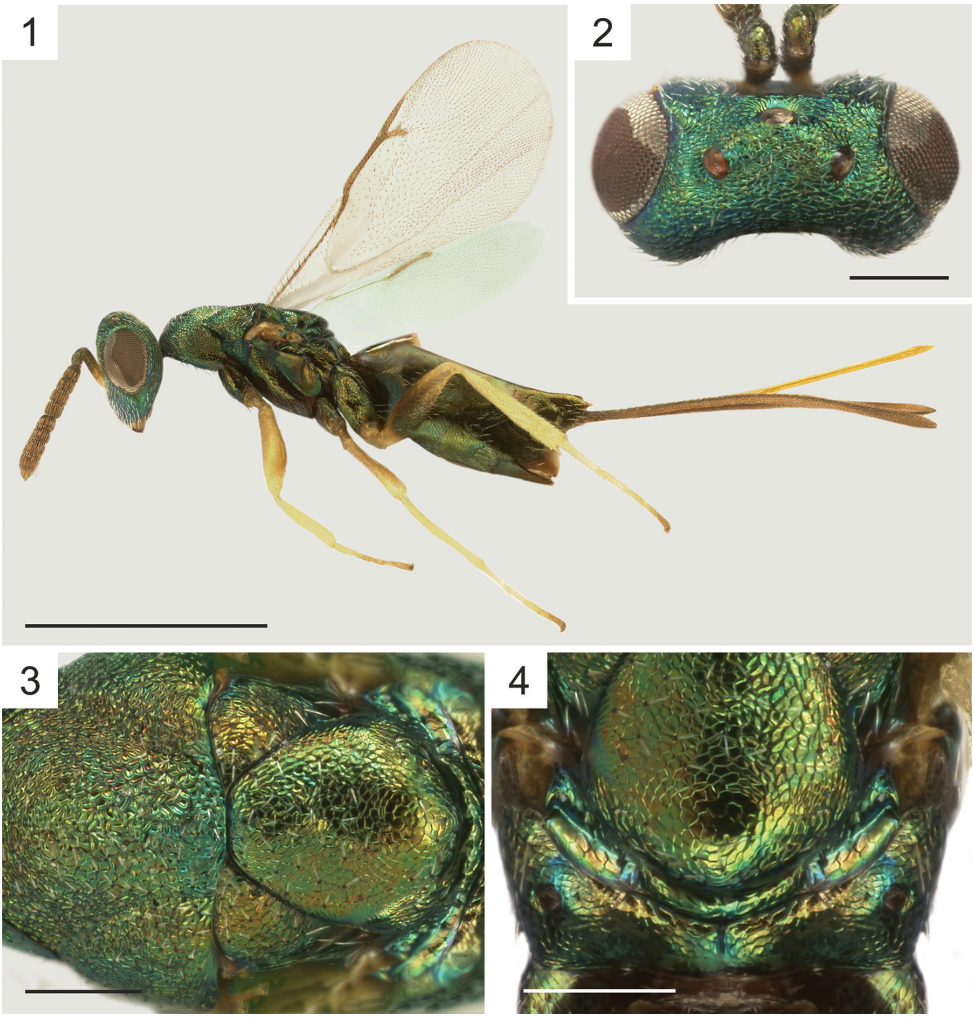
Taxonomy

***Microdontomerus iridis* (Picard, 1930), comb. n.**
Figs 1–25

Callimome iridis Picard, 1930: 89–90, ♀ (original description from France [Provence], syntypes in MNHN); Bernard 1936: 70 (host record of male and female), Graham and Gijswijt 1998: 161 (catalog, species inquirenda)
Torymus iridis: Grissell 1995: 282 (generic transfer, distribution)

Material examined. Neotype female (in MNHN), FRANCE: Hérault, Palavas-les-Flots, between city and Maguelone Cathedral, 1 m a. s. l., 43.515167°N, 3.901833°E, February 1979, ex egg-case of *Iris oratoria* on stake, Foucart A. leg.

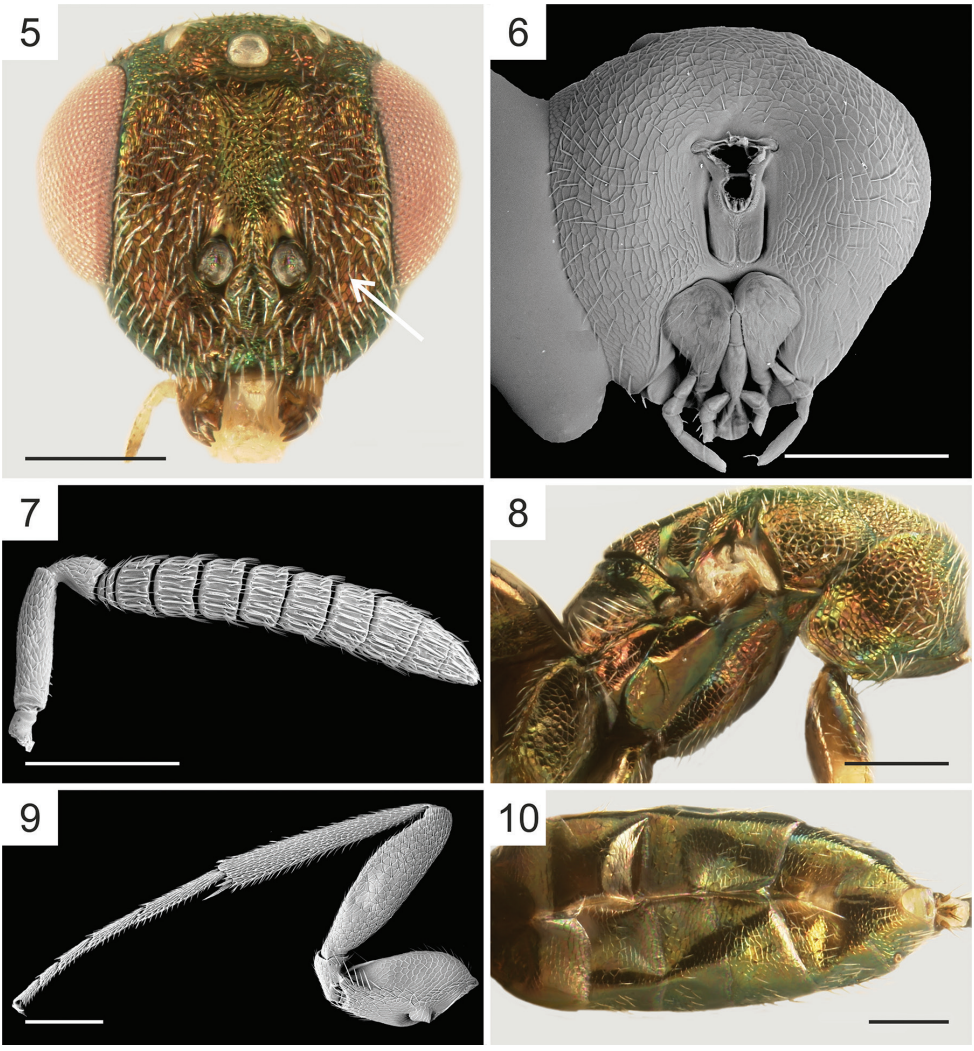
Non-type specimens: FRANCE, same data as neotype, 4 males (in GDPC); Aniane, city, 66 m a.s.l., 43.686528°N, 3.584361°E, 23.vii.1986, ex egg-case of *I. oratoria* on wall, Delvare G. leg., 1 female (in GDPC). GREECE, Kerkini Laka National Park, Ker-



Figures 1–4. *Microdontomerus iridis*, female neotype (scale bar 0.15 mm, unless indicated otherwise). **1** Habitus, lateral (scale bar 1 mm) **2** Head, dorsal **3** Mesosoma (partially), dorsal **4** Mesoscutellum (partially), metascutellum and propodeum, dorsal.

kini Mountains foothills, 41.277868°N, 23.214595°E, 254 m a.s.l., 4.v.2010, ex egg-case of *I. oratoria*, Fusu L. & Popovici O. leg., 9 females, 5 males (in GDPC); SPAIN, Extremadura, rio Magasca, Nordhang, near Trujillo, 5.viii.2009, 10 females, 1 male, em. i. 2010 (1 female), iii.2010 (1 female), v.2010 (4 females), 30.vi.2010 (2 females), 15.vii.2010 (1 male), vii.2010 (2 females) (in SMNS [2 females], ZFMK [2 females], ZMH [6 females, 1 male]); TURKEY, Izmir prov., Cukuralan, GPS 39.17437°N, 026.92825°E, 460m a.s.l., 21.iv.2011, em. 18.v.2011, 8 females, 3 males (in CUPC).

Condition of the neotype. Specimen complete, glued on rectangular card, right hind wing removed and glued on card.



Figures 5–10. *Microdontomerus iridis*, female (scale bar 0.2 mm). **5** Head, frontal, arrow indicates depression in cuticle sculpture (specimen from Greece) **6** Head, posterior (specimen from Turkey) **7** Antenna, lateral (specimen from Turkey) **8** Mesosoma, lateral (specimen from Greece) **9** Hind leg, lateral (specimen from Turkey) **10** Metasoma, dorsal (specimen from Greece).

Comments. The species was described from four females, which were housed in the Abeille de Perrin collection (in MNHN). Locating these specimens remained unsuccessful. The French entomologist Abeille de Perrin lived and worked in Marseille. Therefore, it is possible that the ootheca of *I. oratoria* from which the syntype specimens emerged was collected in the department Bouches-du-Rhône.

Diagnosis. Head 1.09–1.18× as broad as high and 1.87–2.04× as broad as long. Anterior margin of clypeus straight and recessed relative to corners of oral fossa.

Scrobes bare and less sculptured relative to the rest of face and interantennal area. Toruli inserted above ventral level of eye. Face between lateral level of eye and toruli with small depression contrasting with nearby surface sculpture. OOL about as long as LOD. Antenna with scape not reaching anterior ocellus; flagellum with two anelli and six funicular segments, all funicular segments transverse. Posterior part of midlobe of mesoscutum and entire mesoscutellum flattened dorsally; mesoscutellum less sculptured in contrast to pronotum and mesoscutum. Fore wing with speculum reaching end of marginal vein; costal cell dorsally with one row of setae along anterior margin, cubital cell without setae and basal cell at most with few setae along anterior margin; basal and cubital setal line complete; marginal vein 1.40–2.00× as long as postmarginal vein and 2.55–3.78× as long as stigmal vein. All tarsi slightly longer than tibiae, metafemur simple, without any tooth. Metasoma with hypopygium reaching almost end of gaster; Gt_1 incised medially, Gt_2–Gt_3 distinctly emarginate medially, Gt_4–Gt_5 slightly emarginate. Ovipositor 0.65–0.79× as long as body; OI 2.50–2.90.

Description: FEMALE neotype. Body length excluding ovipositor 2.14 mm; length of ovipositor 1.51 mm. Head, mesosoma, meso- and metacoxa and metasoma metallic bronze green with coppery reflections, especially on mesonotum (Fig. 1). Lower part of scape, tegula, pro- and mesofemur and pro-, meso- and metatibia pale yellow. Procoxa brown in proximal part, pale yellow in distal part. Metafemur pale yellow with brownish spot in the middle; pro-, meso- and metatarsus pale yellow proximally and brownish distally. Distal part of scape, flagellum and ovipositor brown. Pedicel brown with metallic reflection. Fore wing slightly infumate, wing venation pale brown, setae brown.

Head. Head 1.10× as broad as high; 1.99× as broad as long (Fig. 2); 1.12× as broad as mesonotum at its widest part in dorsal view. Temple short, strongly converging, one quarter as long as eye. Eyes separated by 1.10× their own height, eye 1.81× as high as long. Head slightly reticulate with thin, short, pale setae on face, vertex and temple which are about as long as two meshes of the reticulation; scrobe more finely reticulate, without setae. Face between lateral level of eye and torulus with small depression in cuticle sculpture (Fig. 5). Clypeus with anterior margin nearly straight and recessed relative to corners of oral fossa; ventral part of clypeus smooth (Fig. 5). Malar space two thirds as long as breadth of oral fossa and 0.49× as long as eye height. Occipital carina absent (Fig. 6). Antenna with scape 3.90x and pedicel 1.46x as long as broad, the former not reaching ventral margin of anterior ocellus; torulus inserted hardly above ventral level of eye. Combined length of pedicel and flagellum 1.20× as long as breadth of head. Flagellum with two anelli, the first narrower, the second as broad as pedicel; remaining flagellomeres barely to distinctly transverse, with F1 the smallest, 0.73× as long as broad, hardly wider than pedicel, and bearing only few MPS; F2–F6 of about same dimensions, 0.79–0.85× as long as broad (Fig. 7). POL 2.94× OOL, OOL 0.98× LOD.

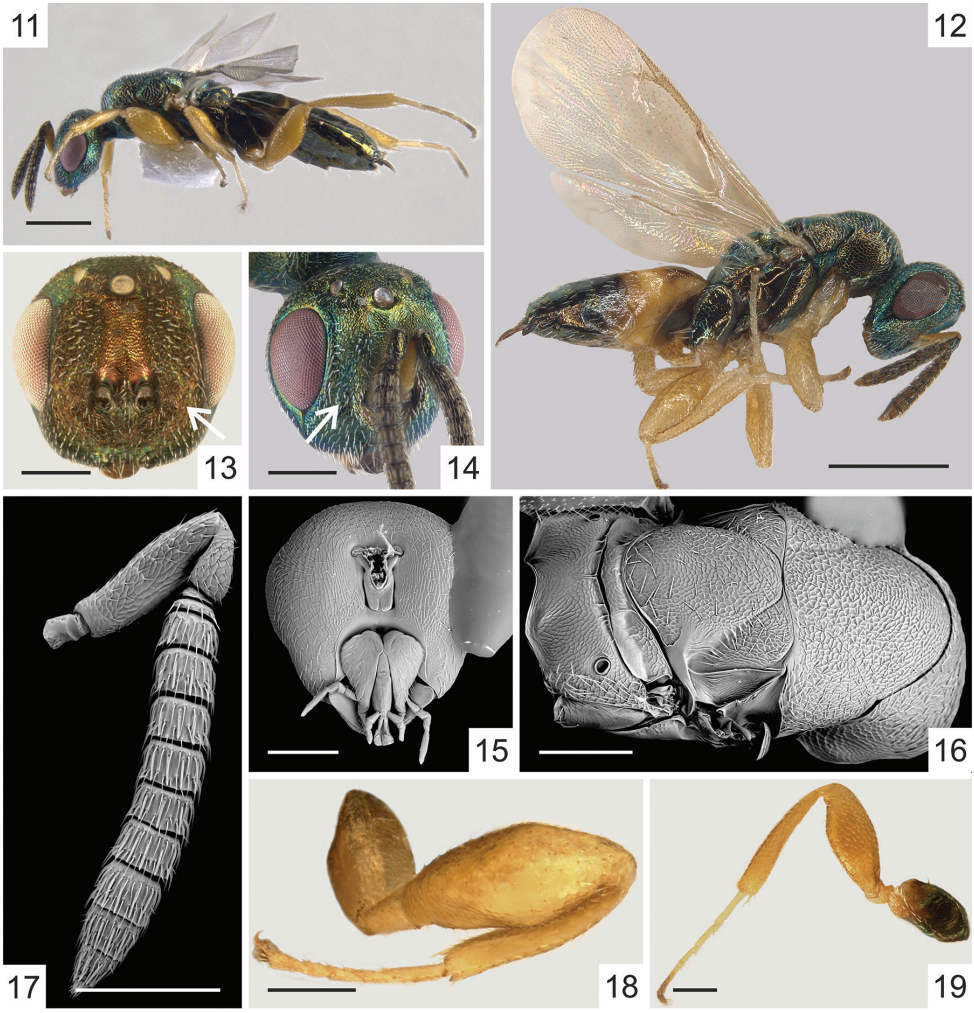
Mesosoma. Mesosoma 1.74x as long as broad. Pronotum 0.78× as broad as mesoscutum. Pronotum and mesoscutum fairly faintly and irregularly reticulate, especially on posterior part of mesoscutum, and covered with thin, short, pale setae (Fig. 3). Pos-

terior part of midlobe of mesoscutum and entire mesoscutellum flattened dorsally (Fig. 8). Notaulus narrow, weakly impressed and obliterated by sculpture. Mesoscutellum 1.06× as long as broad, without frenal area. Mesoscutellum and axilla more sparsely covered with setae and less sculptured than posterior part of midlobe of mesoscutum, partly coriaceous. Propodeum delicately reticulate, with incomplete and barely visible median carina (Fig. 4). Hind leg with coxa alutaceous, covered by setae dorsally and ventrally, 2.53× as long as broad; metafemur 3.59× as long as broad, without any tooth; metatibia 6.76× as long as broad; metatarsus long, 1.04× as long as metatibia (Fig. 9). Fore wing 2.35× as long as wide, slightly infumate along wing venation, with dense brown setae on disc; speculum reaching end of marginal vein; costal cell dorsally with one row of setae along anterior margin, with one row of setae ventrally on basal half and 3–4 rows at end of cell, basal and cubital cell bare; basal and cubital setal line complete; marginal vein 1.82× as long as postmarginal vein and 3.87× as long as stigmal vein; venation pale brown (Fig. 1).

Metasoma. Metasoma 1.24× as long as mesosoma (but somewhat collapsed). Petiole very short, strongly transverse. Gaster with very shallow alutaceous sculpture; Gt_1 incised medially, Gt_2–Gt_3 distinctly emarginate medially, Gt_4–Gt_5 slightly emarginate medially (Fig. 10); tip of hypopygium almost reaching apex of gaster (Fig. 1). OI 2.76.

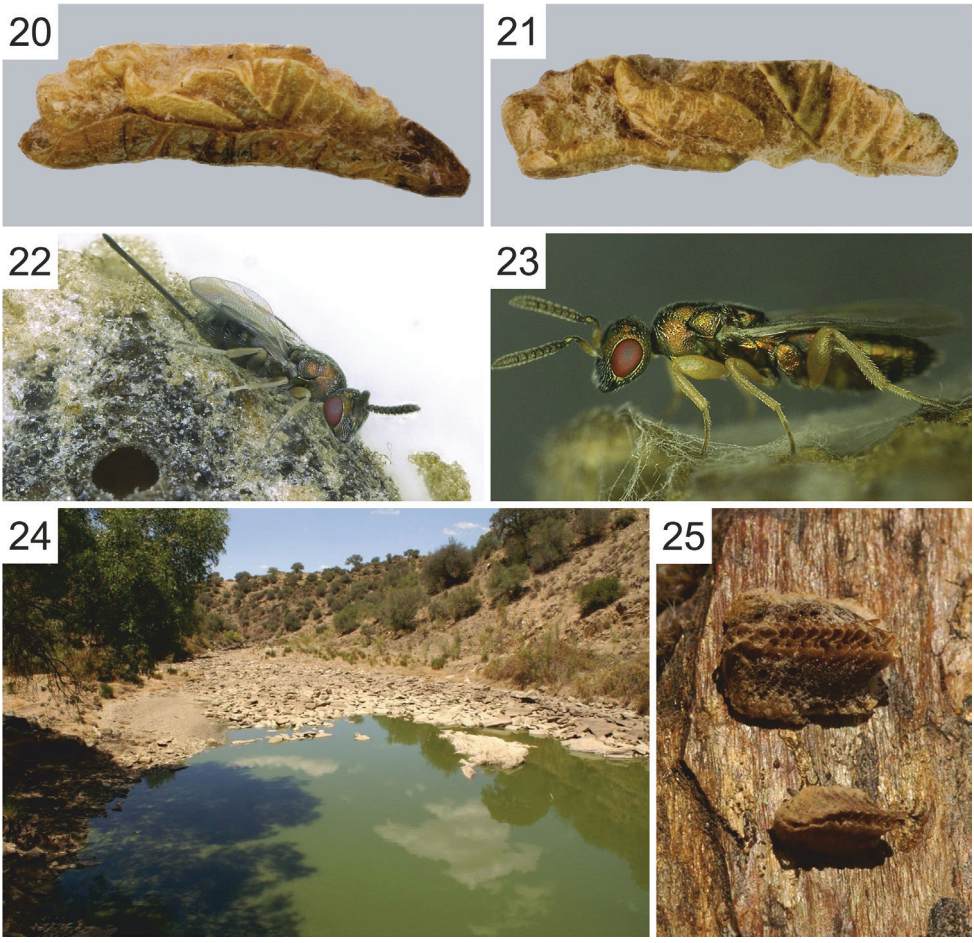
Variation. In a number of specimens the head, mesosoma, meso- and metacoxa and metasoma are metallic coppery green with purple reflections. Scape varies from brown in distal part to entirely brown. Tegula varies from pale yellow to pale brown in distal part or even entirely brown. In some darker specimens the procoxa is pale brown to brown in proximal part or entirely brown, sometimes with metallic coppery green reflections; pro- and mesofemur sometimes pale brown in the middle; metafemur entirely brown with metallic reflections and all tarsi except pretarsus brownish. The mesosoma of the French specimens is more slender than that of the females from Greece. Mesoscutellum and axilla slightly less sculptured than posterior part of midlobe of mesoscutum, almost alutaceous, sometimes only less reticulate. Basel cell of fore wing without setae, in some specimens with up to 10 setae in one row along anterior margin. Body length excluding ovipositor varies between 1.65 and 2.50 mm; length of ovipositor varies between 1.07 and 1.68 mm. Ranges and median of measurements and body ratios are given in App. 2 and 3 (for raw data, see Suppl. material 1).

MALE. Length of body 1.90–2.40 mm. Mostly similar to females (Figs 11, 13, 14, 15, 16) except following: one specimen (Spain) metasoma with yellow subbasal ring extending from distal part of Gt_1 to proximal part of Gt_2 (Fig. 12). Temple long and less converging, 0.32–0.60× length of eye, hence head less transverse, 1.77–1.96× as broad as long. Head with vertex more vaulted. Eye smaller, 1.43–1.6x as high as long, separated by 1.16–1.20× their own height. Oral fossa wider, malar space 0.49–0.51× breadth of oral fossa. Funicular segments somewhat less transverse than in the female. F1 and F2 two third as long as broad, F6 and clava respectively 0.61× and 1.87× as long as broad (Fig. 17). Pro- and metafemur distinctly swollen (Figs 18, 19), 2.14–2.35× respectively 2.57–2.71× as long as broad, the latter distinctly serrate posteriorly. Pro-



Figures 11–19. *Microdontomerus iridis*, male (scale bar 0.2 mm, unless indicated otherwise). **11** Habitus, lateral (specimen from Turkey, scale bar 0.5 mm) **12** Habitus, lateral (specimen from Spain, scale bar 0.5 mm) **13** Head, frontal, arrow indicates depression in cuticle sculpture (specimen from Greece) **14** Head, frontolateral, arrow indicates depression in cuticle sculpture (specimen from Turkey) **15** Head, posterior (specimen from Turkey) **16** Mesosoma, dorsolateral (specimen from Turkey) **17** Antenna, lateral (specimen from Turkey) **18** Fore leg, lateral (specimen from Greece) **19** Hind leg, lateral (specimen from Greece).

podeum sloping at only about 30° relative to surface of mesoscutellum. Other measurements as follows: POL 2.30–2.60× OOL; OOL 1.00–1.30× LOD. The variation in relative length of flagellomeres is as follows: F1 0.40–0.82×, F2–F5 0.64–0.85×, F6 0.67–0.77× and clava 1.87–2.62× as long as broad. Mesosoma and mesoscutellum 1.80–2.00× respectively 1.07–1.21× as broad as long; pronotum 0.75–0.88× as long as mesoscutellum; metatibia 5.70–6.50× as long as broad; metatarsus 1.06–1.08× as long as metatibia; fore wing 2.16–2.3× as long as wide, marginal vein 1.48–2.07× and



Figures 20–25. 20 *Microdontomerus iridis*, lateral, male pupa on host egg (specimen from Spain) **21** *M. iridis*, lateral, male pupa removed from host egg (specimen from Spain) **22** *M. iridis*, female on host ootheca (specimen from Spain) **23** *M. iridis*, male on host ootheca (specimen from Spain) **24** Rio Magasca, Spain, habitat of *M. iridis* **25** *Iris oratoria* (upper) and *Ameles* sp. (lower) oothecae from Spain, rio Magasca.

2.73–3.44× as long as postmarginal vein respectively stigmal vein; metasoma 0.80–1.20× as long as mesosoma but depending on degree of collapsing.

Taxonomic remarks

Taxonomic placement

Microdontomerus iridis (Picard, 1930) was erroneously placed in *Callimome*, now considered a synonym of *Torymus* (see Grissell 1995), and classified in the tribe Torymini.

However, it lacks the defining synapomorphy of Torymini, i.e., the sinuous suture between mesepimeron and metapleuron, with the anterior margin of the metapleuron projecting forward.

In the key to genera of Toryminae by Grissell (1995), *M. iridis* falls into couplet 49 (genera *Idiomacromerus* and *Microdontomerus*). However, Grissell (1995) found it difficult to distinguish some species of *Idiomacromerus* from *Microdontomerus* and vice versa. The only character used for recognition of these two genera was the number of anelli. Later, Grissell (2005) found more reliable characters and separated these two genera based on the presence or absence of the occipital carina. *Microdontomerus iridis* has no occipital carina (Figs 6, 15) which defines the genus *Microdontomerus* (Grissell 1995, 2005). The classification in *Microdontomerus* is also supported by the study of Janšta et al. (unpublished) that uses molecular data to infer the phylogeny of Torymidae. In this study, *M. iridis* is placed within a monophyletic clade together with other species of *Microdontomerus*.

Recognition of the species

Only five species of *Microdontomerus* are known from the Old World: four Palaearctic (*M. albipes* (Giraud, 1870), *M. annulatus* (Spinola, 1808), *M. iridis* (Picard, 1930), *M. ovivorus* (Steffan, 1967)), and one Afrotropical (*M. senegalensis* (Risbec, 1951)) (Noyes 2015). This genus is much more diverse in the Nearctic (Grissell 2005), with 19 species described. *Microdontomerus iridis* differs from the Old World species by the presence of two anelli. However, the list in Noyes (2015) is mostly based, for the Old World species, on the catalogue by Grissell (1995) in which the division between *Microdontomerus* and *Idiomacromerus* is demarcated by the number of anelli. Both the distinction and the accordant list are out of date. An examination of collections at hand showed that several species, which would be classified as *Microdontomerus* according to the presence or absence of an occipital carina (Grissell 2005), are currently included in *Idiomacromerus*. This is the case for *Microdontomerus carayoni* comb. n. (based on the examination of the holotype, in MNHN) and at least four undescribed species, all distributed in the Mediterranean area or Central Asia. They all have extensive pale colouring – mostly yellow – at least on the metasoma, sometimes on the whole body, while *M. iridis* only has very reduced yellow spots on $Gt_{2–5}$, usually visible on specimens in alcohol; in dried specimens the metasoma collapses and tergites overlap each other, masking the yellow spots. *Microdontomerus iridis* indeed differs from the majority of species presently classified in *Idiomacromerus* by the absence of the occipital carina. The specific host is another key feature for the recognition of the species. No other non-podagrionine and non-palachiine Torymidae has been recorded from mantid egg-cases, except *Microdontomerus senegalensis* (Risbec, 1951) (reared from *Tarachodes saussurei*, maybe as hyperparasitoid of podagrionines), which differs from *M. iridis* by having only a single anellus and seven funicular segments according to the original description and illustration (Risbec 1951: fig. 154e, p. 319).

Assignment to *Callimome iridis*

A neotype is designated because we were unable to locate or trace the type specimen or any material referred to by Bernard (1936) in the collection of the Paris museum (MNHN). Apparently, all material used for the description and other publications so far, is lost, and a neotype designation was necessary to fix the taxonomic status of the species. The assignment of the recently reared torymids that we examined in this study to *C. iridis* is based on the fact that *C. iridis* is the only known non-podagrionine Toryminae species from *I. oratoria*, the host from which all specimens examined by us were reared. In fact, surveys of parasitoids of Mantodea in the Palaearctic (unpublished) showed that the parasitoids of *I. oratoria* are host-specific and, except rarely for *Podagrion* spp., do not host-shift to other mantid species. Furthermore, the recently reared specimens completely agree with the original description of *C. iridis*, especially in the colour of the body and appendices, the sculpture of the mesosoma, and the relative length of the exserted part of the ovipositor.

Biology. All specimens were reared from oothecae of *Iris oratoria* (Mantodea). Dissection of additional oothecae with emergence holes (same locality data as the examined *M. iridis* from Spain; oothecae deposited at ZMH) showed that *M. iridis* is an egg ectoparasitoid, feeding on one host egg per specimen (Figs 20, 21). Figs 22 and 23 show a female and a male specimen respectively on its host ootheca.

Distribution. According to published records (Picard 1930), *M. iridis* is restricted to southern France. We significantly expand the known distribution by adding new records from Greece, Spain and Turkey. Based on all parasitoid records and the known host distribution (Battiston et al. 2010) we assume that *M. iridis* is distributed over the entire Mediterranean region. Figures 24 and 25 show the Spanish collection site of *M. iridis* and the host ootheca glued on stone.

Discussion

The most striking feature of *M. iridis*, for which we present all necessary taxonomic actions as well as new data on its life history, is the apparently very specific association with an unusual host, the egg cases of *Iris oratoria*. Although *Microdontomerus* is not a species-rich group with little morphological variation between species, the host range within the genus *Microdontomerus* is very broad. Larvae of *Microdontomerus* species are known as parasitoids of various life stages of Lepidoptera (including eggs), larvae of solitary bees and larvae of Cynipidae (both Hymenoptera) and Tephritidae (Diptera), eggs of beetles (Buprestidae) and Mantodea eggs (two species). Some species are hyperparasitoids of Ichneumonidae, Braconidae (Hymenoptera) and Tachinidae (Diptera) larvae in caterpillars (Lepidoptera) and larvae of Buprestidae, Cerambycidae and Curculionidae (Coleoptera) (Grissell 2005). In fact, the genus is a striking example of the evolution of very different host associations in closely related species that can be found in many groups of Toryminae (see Noyes 2015). However, while we were able

to provide some data for *M. iridis*, in general, little biological information is available for most species of *Microdontomerus*. Verification of host records is required and many biological features still need to be understood before we will fully appreciate the evolution of host associations in *Microdontomerus* and related groups.

Acknowledgements

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Appendix 1

Abbreviation, name and definition of the 62 measurements used in this study (See Material and methods for further information).

Abbreviation	Character name	Character definition
ant.l	Pedicel + flagellum length	Combined length of pedicel plus flagellum, outer aspect (Graham 1969)
aod.d	AOD	Anterior (=median) ocellus diameter
as2.l	Apical spur of mesotibia length	Length of apical spur of mesotibia
as3.l	Apical spur of metatibia length	Length of the longest apical spur of metatibia
bod.l	Body length	Sum of lengths of head, mesosoma and metasoma
cc1.l	Costal cell of fore wing length	Length of costal cell of fore wing, measured from end of humeral plate to the point at which the submarginal vein touches the leading edge of the wing
clv.b	Clava breadth	Greatest breadth of clava, outer aspect (Baur 2015)
clv.l	Clava length	Greatest length of clava, outer aspect (Baur 2015)
eye.h	Eye height	Greatest length of eye height, lateral view (Baur 2015)
eye.l	Eye length	Length of eye, dorsal view (Graham 1969)
fl3.b	First funicular segment breadth	Greatest breadth of first funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fl3.l	First funicular segment length	Greatest length of first funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fl4.b	Second funicular segment breadth	Greatest breadth of second funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fl4.l	Second funicular segment length	Greatest length of second funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fl8.b	Sixth funicular segment breadth	Greatest breadth of sixth funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fl8.l	Sixth funicular segment length	Greatest length of sixth funicular segment (= third flagellar segment), outer aspect (Baur 2015)
fm1.b	Profemur breadth	Greatest breadth of profemur, outer aspect
fm1.l	Profemur length	Length of profemur, from distal end of trochanter to tip of profemur, measured along midline, outer aspect
fm2.b	Mesofemur breadth	Greatest breadth of mesofemur, outer aspect
fm2.l	Mesofemur length	Length of mesofemur, from distal end of trochanter to tip of mesofemur, measured along midline, outer aspect
fm3.b	Metafemur breadth	Greatest breadth of metafemur, outer aspect (Baur 2015)
fm3.l	Metafemur length	Length of metafemur, from distal end of trochanter to tip of metafemur, measured along midline, outer aspect (Baur 2015)
frv.b	Frontovertex breadth	Minimal distance between compound eyes at level level of median ocellus

Abbreviation	Character name	Character definition
fwi.b	Fore wing breadth	Greatest breadth of fore wing, measured at about right angle to marginal and postmarginal veins (Baur 2015)
fwi.l	Fore wing length	Greatest length of fore wing, measured from end of humeral plate to tip of wing (Baur 2015)
hea.b	Head breadth	Greatest breadth of head, dorsal view (Baur 2015)
hea.h	Head height	Distance between anterior margin of clypeus and anterior edge of anterior ocellus, frontal view (Baur 2015)
hea.l	Head length	Length of head, dorsal view (Graham 1969)
hwi.b	Hind wing breadth	Greatest breadth of fore wing, measured at about right angle to marginal and postmarginal veins
hwi.l	Hind wing length	Greatest length of hind wing, measured from end of humeral plate to tip of wing
hwv.l	Hind wing venation length	Combined length of submarginal and marginal vein of hind wing, measured as direct distance from end of humeral plate to the apical end of marginal vein
lof.h	Lower face height	Distance between anterior margin of clypeus and lower margin of torulus (Baur 2015)
mav.l	Marginal vein length	Length of marginal vein, distance between the point at which the submarginal vein touches the leading edge of the wing and the point at which stigmal vein and postmarginal vein unite (Graham 1969)
msc.b	Mesoscutum breadth	Greatest breadth of mesoscutum just in front of level of tegula, dorsal view (Baur 2015)
msc.l	Mesoscutum length	Length of mesoscutum along median line from posterior edge of pronotum to posterior edge of mesoscutum, dorsal view (Baur 2015)
msp.l	Malar space	Distance between the point where malar sulcus enters mouth margin and malar sulcus enters lower edge of eye, lateral view (Graham 1969)
mss.l	Mesosoma length	Length of mesosoma along median line from anterior edge of pronotum collar to posterior edge of nucha, dorsal view (Baur 2015)
mts.l	Metasoma length	Length of metasoma, measured from anterior margin of petiole to the tip of the last gastral tergite, dorsal view
of.b	Oral fossa breadth	Intermalar distance, ventral view (Graham 1969)
ool.l	OOL	Shortest distance between posterior ocellus and eye margin, dorsal view (Graham 1969)
ovi.l	Ovipositor length	Length of ovipositor, measured as the part of the ovipositor sheaths that extend beyond the tip of the last gastral tergite
pdl.b	Pedicel breadth	Greatest breadth of pedicel, outer aspect (Baur 2015)
pdl.l	Pedicel length	Length of pedicel, outer aspect (Baur 2015)
pmv.l	Postmarginal vein length	Length of postmarginal vein (Graham 1969), distance between the point at which the stigmal vein and postmarginal vein unite, apically to where the vein appears to end (Baur 2015)
pnt.l	Pronotum length	Distance between anterior edge of neck to posterior edge of collar, lateral view
pod.d	POD	Posterior (=lateral) ocellus diameter
pol.l	POL	Shortest distance between posterior ocelli, dorsal view (Graham 1969)
scp.b	Scape breadth	Greatest breadth of scape, outer aspect (Baur 2015)
scp.l	Scape length	Length of scape exclusive of radicle, outer aspect (Graham 1969)
sct.b	Mesoscutellum breadth	Greatest breadth of mesoscutellum (=scutellum), dorsal view
sct.l	Mesoscutellum length	Length of mesoscutellum (=scutellum) along median line from posterior edge of mesoscutum to posterior edge of mesoscutellum, dorsal view (Baur 2015)

Abbreviation	Character name	Character definition
stv.l	Stigmal vein length	Length of stigmal vein, distance between the point at which stigmal vein and postmarginal vein unite apically, and the distal end of the stigma (Graham 1969)
ta1.l	Protarsus length	Length of protarsus, including pretarsus
ta2.l	Mesotarsus length	Length of mesotarsus, including pretarsus
ta3.l	Metatarsus length	Length of metatarsus, including pretarsus (Baur 2015)
tb1.l	Protibia length	Length of protibia, measured along midline, outer aspect
tb2.b	Mesotibia breadth	Apical breadth of mesotibia, outer aspect
tb2.l	Mesotibia length	Length of mesotibia, measured along midline, outer aspect
tb3.b	Metatibia breadth	Apical breadth of metatibia, outer aspect (Baur 2015)
tb3.l	Metatibia length	Length of metatibia, measured along midline, outer aspect (Baur 2015)
tmp.l	Temple length	Length of temple, dorsal view (Graham 1969)
tod.b	Torulo-ocular distance	Breadth of distance between outer margin of torulus and inner margin of eye, measured along an imaginary line connecting the ventral margins of the antennal toruli, frontal view

Appendix 2

Overview of 62 measurements (in μm) of *Microdontomerus iridis* showing minimum, maximum and median values for each character (See Appendix 1 for character name and definition).

	Female			Male		
Measurement	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**
hea.b	459	614	570	530	617	600
hea.l	236	311	290	270	344	330
hea.h	392	530	500	473	584	554
frv.b	257	338	324	331	392	338
eye.l	170	220	200	180	315	233
tmp.l	35	70	60	75	110	105
pol.l	61	170	160	140	180	178
ool.l	42	65	58	60	75	70
pod.d	40	60	50	50	69	60
aod.d	47	62	56	82	82	82
eye.h	250	338	300	260	325	300
msp.l	95	155	130	130	159	150
of.b	182	260	230	260	320	297
tod.b	115	115	115	904	1041	952
lof.h	117	117	117	158	158	158
scp.l	180	200	190	200	224	210
scp.b	47	60	60	60	70	60
pdl.l	60	80	80	75	85	80
pdl.b	45	69	50	50	58	50
ant.l	425	653	633	677	677	677
fl3.l	47	60	55	20	50	45
fl3.b	60	80	73	50	76	60
fl4.l	50	65	56	45	56	55

	Female			Male		
Measurement	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**
fl4.b	66	90	78	60	84	65
fl8.l	50	70	60	50	58	55
fl8.b	75	100	85	65	95	75
clv.l	150	190	179	140	178	170
clv.b	70	100	85	60	80	75
mss.l	617	950	870	797	1030	945
msc.b	411	567	520	473	594	512
pnt.l	149	257	223	243	297	257
msc.l	253	392	361	338	405	378
sct.l	243	338	320	311	340	320
sct.b	233	320	308	280	322	290
fm1.l	288	397	384	400	508	470
fm1.b	82	128	116	170	224	210
tb1.l	288	341	320	452	452	452
ta1.l	346	346	346	406	406	406
fm2.l	397	410	404	480	480	480
fm2.b	96	98	97	151	151	151
tb2.l	288	443	431	541	541	541
tb2.b	64	64	64	89	89	89
as2.l	78	78	78	103	103	103
ta2.l	370	494	420	?	?	?
fm3.l	384	570	505	460	572	540
fm3.b	96	160	150	170	216	210
tb3.l	432	675	610	530	657	630
tb3.b	80	105	90	90	110	100
as3.l	81	81	81	81	81	81
ta3.l	466	720	625	560	700	680
fwi.l	1315	1760	1620	1380	1808	1600
fwi.b	548	830	720	600	822	730
cc1.l	466	636	603	712	712	712
mav.l	270	340	310	270	320	310
stv.l	78	110	100	78	110	100
pmv.l	160	230	180	140	210	170
hwi.l	932	1233	1192	1329	1329	1329
hwi.b	247	307	288	301	301	301
hwv.l	521	736	699	795	795	795
mts.l	849	1300	1075	780	1200	959
ovi.l	1069	1720	1600	?	?	?
bod.l	1644	2500	2155	1900	2400	2200

Appendix 3

Overview of ratios of various measurements of *Microdontomerus iridis* showing minimum, maximum and median values (See Appendix 1 for character name and definition).

	Female			Male		
Ratio of measurements	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**
hea.b / hea.l	1.87	2.04	1.96	1.73	1.96	1.79
hea.b / hea.h	1.09	1.18	1.13	1.03	1.16	1.09
frv.b / eye.h	0.96	1.1	1.01	1.13	1.2	1.19
pol.l / ool.l	2.5	3.1	2.74	2.27	2.6	2.43
ool.l / pod.d	0.91	1.3	1.1	1	1.27	1.2
msp.l / eye.h	0.38	0.49	0.44	0.48	0.51	0.5
msp.l / of.b	0.52	0.76	0.57	0.47	0.54	0.5
ant.l / hea.h	0.93	1.2	1.14	1.1	1.1	1.1
scp.l / scp.b	3	4.15	3.25	3	3.73	3.5
pdl.l / pdl.b	1.13	1.6	1.45	1.38	1.7	1.55
fl3.l / fl3.b	0.63	0.92	0.75	0.4	0.82	0.69
fl4.l / fl4.b	0.63	0.87	0.7	0.64	0.85	0.77
fl8.l / fl8.b	0.56	0.87	0.7	0.61	0.77	0.69
clv.l / clv.b	1.67	2.6	2.12	1.87	2.97	2.27
mss.l / msc.b	1.41	1.86	1.69	1.34	2	1.89
msc.l / msc.b	0.62	0.74	0.67	0.59	0.82	0.75
pnt.l / sct.l	0.6	0.79	0.69	0.75	0.88	0.81
sct.l / sct.b	0.98	1.14	1.03	1.01	1.21	1.1
fm1.l / fm1.b	3.1	3.5	3.29	2.14	2.35	2.29
ta1.l / tb1.l	1.01	1.08	1.05	0.9	0.9	0.9
ta2.l / tb2.l	0.97	1.29	1.12	?	?	?
fm3.l / fm3.b	3.27	4	3.55	2.57	2.71	2.62
ta3.l / tb3.l	1.02	1.11	1.05	0.98	1.08	1.08
fwi.l / fwi.b	2.05	2.5	2.29	2.16	2.3	2.22
cc1.l / fwi.l	0.35	0.37	0.37	0.39	0.39	0.39
mav.l / stv.l	2.55	3.87	3.1	2.73	4.03	3.1
mav.l / pmv.l	1.4	2	1.7	1.48	2.07	1.88
hwi.l / hwi.b	3.78	4.14	4.02	4.41	4.41	4.41
mts.l / mss.l	1.16	1.53	1.24	0.8	1.2	1.05
ovi.l / tb3.l	2.44	2.86	2.63	?	?	?
ovi.l / bod.l	0.65	0.79	0.72	?	?	?

Supplementary material 1

Measurements of female and male characters of *Microdontomerus iridis* used in this study

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Data type: measurement

Explanation note: Measurements (in μm) of female and male characters of *Microdontomerus iridis* used in this study (See Material and methods for collection acronyms; see Appendix 1 for character name and definition).

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